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Art. I. *On Absorption.* By Samuel Jackson, M. D. Assistant to the Professor of the Institutes and Practice of Medicine and Clinical Practice in the University of Pennsylvania.

THE existence of organized beings is made to depend on supplies of nutritive materials derived externally, and the incessant renewal of the elements of their composition. Those supplies must, consequently, be introduced into the interior of the organism; and the elements that have subserved the purposes of vitality be removed for their exterior elimination. A centripetal, and a centrifugal action are, thus, unceasingly maintained. The condition above stated necessitates a function for its fulfilment; and this function, absorption, we propose to investigate, to determine its relation to the physiological and pathological state.

Absorption it is seen accomplishes different objects: it might, then, be inferred, a priori, that it is not a simple, single, and uniform process.

In the simpler animals of the lowest classes, whose structure is a single tissue of homogeneous nature, consisting of a single element—neither vessels, organs, nor apparatus, for the execution of functions exist. The molecular elements of their structure, being every where the same, maintain, with each other, and with exterior matters, the same relations. Each part possesses within itself the conditions of its existence, independent of any other. Aggregation and a determinate form, are the sole requisites of the animal organization.

Placed in the media containing the elements of their being, each molecule attracts, or takes up, in a direct manner, and by its inherent powers, the supply necessary for animal existence. In such beings, organs and functions are dispensed with: and absorption is a property of the molecular structure, effected by a molecular action. But a structure similar to that of the simpler, exists in the more perfect classes of animals; it constitutes the basis, or first element of their organization, forming the web, as it were, of the organs: this molecular absorption, consequently, exists in them.

In the more complex organizations, composed of different elements and organs, and whose various portions possess relations with each other, and with external agents wholly dissimilar, simple molecular absorption could not alone fulfil the various necessities of the being. Functions are, then, present, executed by an apparatus; and, for absorption, an especial structure, or set of organs, is superadded to the molecular absorption, without this last being superseded.

In the human organization absorption is not, then, always an identical process. It partakes equally in the composition of the body, by conveying into it the materials of its structure; and in its decomposition, by taking up, for external elimination, the elements rendered effete and exhausted by vital processes. It may appropriately, therefore, be divided into external and internal absorption. The first is of two-fold character: first, as introducing into the economy, from the intestinal canal, the nutritive elements prepared by digestion; and 2d, as taking up exterior matters unchanged in their nature and properties.

Internal absorption is likewise of two kinds: the absorption of lymph, or white fluids, performed by lymphatics; and of blood, or coloured fluids, executed by veins. In both these classes of absorption, free or disengaged molecules on the surfaces of the tissues, or in the intimate texture of the organs, are seized on, and conveyed into the sanguine apparatus, the common receptacle of the principles destined for nutrition, and for elimination. The movement of the absorbing system is concentric or centripetal—that of the sanguine is eccentric or centrifugal. The two systems are not in direct communication: at one extremity the heart is interposed between them; at the other, intermediate to the arteries, the veins and lymphatics, are the capillaries and the areolar, interstitial meshes, or spaces of the ultimate molecular structure, through which the fluids meander, as may be demonstrated by the microscope.

In examining this function, a general outline of the apparatus executing it, will be the first subject of consideration.

Apparatus of Absorption.—The general view presented of the function of absorption indicates a diversified mode of action, and a varied apparatus. The elementary, or molecular absorption, is evidently a property of the structure in which it occurs, independent of special organs: it is a molecular action. This is, probably, the rudiment, or the commencement of the action of the lymphatic vessels themselves; but it is too recondite, and passes too deeply in the organism to have its positive character clearly determined. This species of absorption exists in the cellular tissue, the serous and mucous tissues, the elastic fibrous tissue composing the vessels, as has been established by the experiments of M. FODERA and M. MAGENDIE, and may be regarded as attached to all the solids. This species is very analogous to imbibition, and it explains the mode of action of many remedies whose effects are obtained by applying them in the vicinity of the part modified by them.

Absorption was for a long period, and until within a few years, supposed to be the exclusive office of the lymphatic vessels or absorbents as they were called. This system of vessels enters into the composition of nearly all the organs of the economy. It takes its origin from all the internal and external surfaces, and from the intimate, interior texture of the organs: it terminates by two central trunks, opening into the subclavian veins, close to the termination of the venous system itself in the heart. The vessels of this system anastomose infinitely, and their course is interrupted by numerous small bodies, called ganglions.

The absorbent system has been separated into two divisions: the chyliferous, either mediately or directly communicating with the cavity of the small intestine, and terminating in the reservoir of Pecquet; and the lymphatics, arising from other surfaces and portions of the body, and finishing as already mentioned. This division is not founded on a difference in the structure of these vessels, but on the respective offices in which they are engaged.

The lymphatics follow the course of the veins, and like them present two layers, one superficial, under the skin, and the other profound, accompanying the deeper vessels. They are furnished with numerous valves, formed by a duplication of their inner membrane, and placed at unequal distances. They are supplied with blood-vessels, and, probably, nerves, though they are not to be detected.

The mode of origin of the lymphatics is yet a subject of controversy. HEWSON and MONRO believed they commenced with open orifices; but this is denied by FOHMANN, who asserts, that in fishes he has observed their commencement to be in a cul-de-sac.

It has been advanced by Professor LIPPI, that he has succeeded in discovering direct lateral communications by large trunks between the lymphatics and veins. Fohmann declares that in this respect an error has been committed, and that veins were mistaken for lymphatics: in this opinion he is sustained by the accurate researches of Dr. Rossi, of Bologna, who has shown these supposed lymphatic vessels to be venous trunks.

The ganglions are flattened, oblong bodies, of various sizes, from that of a small millet seed to that of a bean: they occur at unequal but short intervals along the course of the lymphatics; are of a pale reddish-white colour, except in the lungs, where they are blackish, and yellow near the liver; they are seldom isolated, being generally placed in groups.

The structure of the ganglions is not positively decided. They have been regarded as composed simply of lymphatics, infinitely convoluted. But the more general doctrine represents them as consisting of the lymphatics, convoluted, anastomosing together, and divided into cells in the manner of the veins of the penis. The vessels entering the glands are called *afferent;* those passing out, less numerous than the others, are named *efferent.* The ganglions are richly supplied with blood-vessels, both arteries and veins, ramifying between the small cells of its interior, somewhat analogous to the erectile tissues. It is asserted by Fohmann and Meckel, that a direct communication exists in the ganglions, between the lymphatics and the veins, by which substances are introduced immediately into the circulation. This opinion is countenanced by the smaller number of *efferent* than *afferent* vessels; and appears further to be established by the matter of injections into the lymphatics, passing in the ganglions into venous trunks; yet this circumstance must not be too exclusively relied on, as the force of the injection may cause an artificial communication.

The veins, before the discovery of the lymphatics, were supposed to perform the office of absorption. But, after the experiments of J. Hunter, all participation in this function was denied to them. Whatever may be the doubts entertained as to their concurrence in general absorption, they are the agents, unquestionably, of absorption for the sanguine or nutritive humour from the spongy or areolar texture of the organs.

The commencement of the veins is so deeply buried in the minute structure, as to be observed with difficulty. It is a common opinion entertained by the physiologists of England and this country, that the veins and arteries are continuous, the one into the other, forming a closed system, and a direct unbroken circulation. This is certainly correct in some respects. In examining the circulation by the microscope in diaphanous membranes, the blood can be seen to make a circuit, changing its course from a centrifugal to a centripetal direction, evidently passing from an artery into a vein. A very limited portion only of the circulation, however, exhibits this phenomenon; for the larger portion of it no direct return is apparent. The globules of the blood pass off in diminishing channels, until every appearance of vascularity ceases. They, then, move with great irregularity in various currents, some with extreme velocity, others with a scarce perceptible motion, and without a positive direction. Many are arrested, and become fixed; and in parts where no movement is discernible, currents of globules are suddenly formed, giving the appearance of a vascular structure. Such is the character of the last circulation, as it has presented itself to me, in repeated observations made with the microscope. The circulation in this portion of it ceases to be conducted by vessels; it is clearly extra vasa, and is seated in an areolar and interstitial structure.

The sanguine globules of this interstitial or areolar circulation, are reconveyed into the general or vascular circulation by the venous radicles into which they are introduced by the process designated absorption. It is in this manner the veins absorb, or remove the blood from the erectile tissues, when the excitement directing the blood into them has ceased; as in the penis, nipple, &c. It is this process, also, that disburdens inflamed and irritated parts of the blood effused by the congestion attending those states, and which often persists after their cessation.

The precise structure of the venous radicles, too delicate, and too intimately woven into the minute structure, like the lymphatic radicles, to be detected by our means of observation, remains unknown. Of the veins, the conductors of the absorbed fluids and refluent blood, it is unnecessary to add a particular description, as they are well known.

There is one portion, however, of the venous system meriting a particular notice: it is the vena portæ, or the portal system. The blood distributed to the abdominal viscera for the purposes of nutrition and secretion, is collected into delicate capillary veins; these pass into larger branches, and, finally, form one large trunk. This trunk, entering into the liver, divides again into numerous branches, terminating in capillaries. It is perfectly clear that the movement of the sanguine fluid in this system cannot be accomplished by the impulsive action of the heart: neither is it effected by the veins proceeding from the various organs, or from the vena portæ itself, nothing in their structure endowing them with a force of the kind. The movement of the portal blood, must, then, be derived from the capillary extremities, or by a force impelling it on the one part, and attracting it on the other. The portal circulation throws light on the general venous circulation, and removes the necessity of calling into its aid the power derived from the contraction of the heart.

The venous radicles of the mesaraic veins, forming part of the portal system, take their origin in the villosities of the intestines. LIEBERKUHN, MECKEL, and RIBES, by injecting these veins, have filled the villosities of the intestinal mucous tissue, and have seen the substance of the injection ooze into the cavity of the intestine. The same circumstance occurs in injecting the lacteals; exhibiting nearly a similar origin to both these vessels.

Of Chyle and Lymph.—Chyle is the fluid found in the lacteals, or chyliferous vessels and thoracic duct, from two to four hours after taking food. It is formed from the nutritive elements, prepared by the digestive processes already described, and taken up from the cavity of the intestinal canal. Chyle is not the product of digestion, for it is not detected in the contents of the alimentary tube: its first appearance is in the lacteals themselves, and it does not present its perfect characters until it has passed the mesenteric ganglions.

The elaboration of chyle from its crude principles, derived from the products of digestion in the small intestines, is the function or office of the lacteals and their ganglions, and this fluid, or humour, acquires animal properties in its progress through this apparatus. According to the experiments of EMMERT, GMELIN, TIEDEMANN, and VAUQUELIN, the coagulability of the chyle, its reddish tinge, and its approach to the characters of blood, are in proportion to its advance towards and along the thoracic duct.

The chyle is not uniform, but varies in some respects, according to the nature of the food. It is always of a white or milky colour, when animal, fatty, or oleaginous substances have entered into the diet. This appearance is due to the presence of oil in the chyle, for, when treated by sulphuric ether, which dissolves the oil, it becomes diaphanous. The chyle proceeding from vegetable aliment is always transparent.

Chyle, according to MARCET, formed of vegetable or animal food, presents other differences. The first contains more carbon than the second; it yields likewise much less sub-carbonate of ammonia; and its coagulum is less putrescent. Magendie states that the chyle from sugar contains less fibrin than that from flesh; and that the serum, coagulum, and fatty matter of the chyle varies constantly, according to the nature of the food. Other differences, though they have not been made the subject of observations, doubtless exist, derived from the kind of aliment: food of a bad and innutritious quality cannot furnish good and wholesome chyle, and is often a source of disease.

Colouring, odorous, and other adventitious matters mixed with the food, do not affect the chyle. The contrary was supposed to have been established by the experiments of John Hunter, who believed he had witnessed the colouring matter of indigo in the lacteals. But it has been shown by Drs. LAWRANCE, COATES, and HARLAN, of this city, in their experiments on absorption, that, in this respect, that distinguished physiologist was deceived by an ocular illusion. It is now perfectly well determined, by the experiments of M. Magendie and others, that the chyle is not affected by foreign matters mixed with the aliment, or introduced into the intestinal canal.

The *lymph* is less accurately known than the chyle. From the observations to which it has been subjected, it is represented as a transparent, colourless fluid; though it is said by some to possess a light rose tinge: it is viscous, and essentially albuminous. Its chemical composition exhibits some analogy with that of the blood: it coagulates, separating into a serum similar to that of the blood, and a coagulum.

The origin of the lymph is not absolutely decided. M. Magendie, who denies entirely lymphatic absorption, regards it in nearly the same view as the ancients. He believes it to be a portion of the blood returned back to the circulation through the lymphatics, as venous blood is returned through the veins. Lymph on this hypothesis is white blood. Many ingenious, and some forcible arguments are deduced in favour of this opinion. It is not without foundation, but its error is in being too exclusive.

Many tissues, in their natural state, do not admit into them red globules: their circulation consists entirely of white blood; their nutrition is derived wholly from white fluids; such are the serous, the fibrous, the cellular, the cartilaginous tissues, and, probably, the large portion of the medullary nervous tissue. Now, this portion of the sanguine nutritive humour constitutes, it is more than probable, the lymph; for, no other fluid approaches as closely to the blood in its characters, and is, consequently, as well adapted to vital actions. The white blood, or nutritive humour of the white tissues, and the lymph may, then, be regarded as the same fluid; and it is the office of the lymphatics to restore it back to the circulation. But while this is a specific office of the lymphatics, it is not incompatible with a function of absorption. It is singular that M. Magendie should have so strenuously contended for absorption by the veins as an addition to their office in the circulation, and yet have excluded it wholly from the office of the lymphatics. The two systems of vessels possess so close an analogy, that functions of the same order may fairly and safely be attributed to them.

The lymph may, then, be considered as derived from the excess of the nutritive fluids of the white tissues returned into the circulation, and of the disengaged molecules of these tissues set free in the decomposing process of their renewal by nutrition. With it, will also be mixed extraneous matters, that may accidentally happen to be placed within the sphere of the white fluids.

Mechanism or Process of Absorption.—The mode in which absorption takes place, has excited the curiosity, and embarrassed the ingenuity of physiologists to explain. Various hypotheses have been devised for this purpose; few of them, however, pretend to any positive facts in their support. It is generally supposed that the lacteals open into the intestines by patulous orifices, and the chyle, entering into them by capillary attraction, is, then, transmitted by a contractile power in the coats of the lacteals. It is a conjecture of Bichat, that the orifices of the lacteals are endowed with a specific sensibility, which causes them to admit the chyle, and to reject all other matters. These are little more than supposititious conjectures, and very slight evidence to the correctness of any one of them can be adduced. Resort has been had to these explanations, as it appears to have been generally admitted, that no other than physical powers existed to produce the movements of the fluids. Other forces do exist, as will be shown; and, hence, the admission of those hypotheses is entirely unnecessary.

The lacteals bear a very striking analogy to the roots of plants. These absorb from the soil the nutritive elements of the vegetable, prepared by decomposition, or putrefactive fermentation: those absorb the nutritive elements of the animal, from the intestinal canal, prepared by the process of digestion. The means adequate to the process in the one, it is a fair inference, are those employed in the other. Now, it is positively determined, the roots of plants have no vessels with patulous openings, but terminate in a cellular texture, named, by De Candolle, spongiole, with which are connected the lymphiferous vessels, conveying the sap, or absorbed fluid, to the leaves. Capillary attraction, consequently, can have no participation in the process. As little influence, also, has contraction, or the principle, contractility, whose existence is assumed for the purpose of is explanation, in producing the transmission of the absorbed fluids the lymphiferous or sap vessels; for, some of these pass through e duramen, as well as the alburnum, which is dense, and can ad-it of no contraction: they may be regarded merely as inorganic bes. Besides, M. DUTROCHET has established most clearly by his xperiments, that the power impelling the movement of the sap, pro-eeds from the spongiole. This power possesses great force. The ex-eriments of HALES, corroborated by those of MIRBEL and CHEV-EUL, show that, in the vine, it is capable of raising a column of mer-ury from twenty-nine to thirty-three inches above its level. Now, e spongiole is too delicate in its structure to display a force of this ind by its physical properties, and it must proceed from a source, holly unconnected with physical powers.

The absorption of fluids, and their movements in the vessels of lants, being shown to proceed from other sources than capillary at-action and vascular contraction, the same force, and mode of opera-on, are fully adequate to the same actions in the lacteals of animals.

This force M. Dutrochet has demonstrated by a consecutive series f experiments and deductions, happily conceived and philosophically rranged,[*] to be an electric phenomenon, and to have existence henever vesicles, pouches, or sacs, either animal or vegetable, con-aining a fluid, are in contact with a fluid of less density: the last is hen constantly introduced within the vesicle or pouch, and, if a ube be attached to this, will rise in it to a considerable height. This ower M. Dutrochet has named *endosmose*.[†] The experiments of utrochet have been repeated and extended at my suggestion by r. TOGNO, of this city,[‡] who has verified their accuracy. It is be-ides well known, that galvanic currents are capable of transporting ot only fluids, but even solid substances through pervious tissues, nd, according to the experiments of Wedemeyer, through inorgan-zed matter.

Dr. Staples, of this city, has varied the experiments of Dutrochet, y employing coloured substances, and saline solutions, which has ed to singular results. He introduced into small pieces of the intes-ine of a chicken, secured at each end, a portion of solution of gum Arabic, and a solution of rheine, the active principle of rhubarb. These, in a partially flaccid state, were placed in pure water. En-dosmose took place, the small sacs of intestine became distended by the introduction of the water into them, but the rheine passed out by exosmose at the same time, and was detected in the water. When the internal contents were examined, no indication of the presence of rheine was afforded. It is thus seen that rheine passes by exosmose from the interior of sacs formed of animal matter, at the same time that endosmose is taking place for fluids.

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[*] L'Agent Immédiat du Mouvement Vital, &c. Par M. H. Dutrochet.

[†] Ενδον, within; ωσμος, impulse.

[‡] Experiments on Endosmose and Exosmose, American Journal of the Medical Sciences, May, 1829.

A weak solution of sulphate of iron was introduced into small sacs formed of the intestine of a chicken, which were placed in a weak solution of prussiate of potash. Endosmose occurred, and the sacs were distended by the passing of the water into the interior of the sac, but not a particle of the prussiate of potash of the solution had been introduced into it. The sulphate of iron had, at the same time, been carried by exosmose from the interior of the sac externally, and formed Prussian blue in meeting with the prussiate of potash. When this experiment was reversed, the prussiate escaped by exosmose externally, and formed Prussian blue by meeting with the sulphate of iron. In these experiments, when the mucous coat was on the exterior by the inversion of the intestine, the phenomena were more promptly produced, and the villi were deeply dyed by the colouring matters.

From these last experiments it would appear that animal tissues expel saline matters by exosmose, while they introduce water by endosmose.

We arrive thus at the evidence of the existence of a force, capable of producing all the phenomena of absorption, the progression of the lymph and chyle, and of the capillary circulation, without having recourse to the hypothesis of capillary attraction, and a contractile power in capillary vessels. We have, in addition, the demonstration that this force can be brought into activity in organized tissues, producing the absorption and adfluction of fluids; and we have established, consequently, the very strong probability, that the introduction of the sap, and its circulation in plants, and of chyle, and its progression with that of the lymph in animals, are accomplished by this force, and in a manner analogous to artificial endosmose.

In the present state of our information, it is not prudent to advance beyond the simple indication of the agent, which, strong probabilities justify us to believe, accomplishes absorption; and the general manner of its performance. The minuter details must be left to future periods, when they will be placed within the reach of explanation, from the facts evolved by profounder observation, multiplied experiment, and more extended research. The cultivation of electro-dynamics, developing a knowledge of their forces, and their application to physiological phenomena, will, I do not question, clear the path of the medical philosopher of a large portion of the difficulties that now impede his progress, and render that clear and explicit which is now dark and confused.

A question much agitated within a few years, and yet awaiting a decision, is venous absorption. M. Magendie would restrict general absorption exclusively to the veins, while many continue to believe, with J. Hunter, that the lymphatics alone are the agents of absorption. The majority of sound physiologists are, however, disposed to admit this function to be exercised by both systems of vessels; and this inference might, a priori, have been drawn from the similarity in the structure of the two, their close connexion, and the analogy of their offices. In the brain, anatomists have been as yet completely foiled in detecting lymphatics, and if they do not exist there, the absorption of the arachnoid fluid, &c. must be effected by venous radicles.

Those who deny venous absorption, in order to avert the force of the experiments of Magendie, and his supporters, allege the existence of very short and minute lymphatics, communicating with the small veins at their commencement, and in the lymphatic ganglions, through which foreign substances gain an immediate admission into the veins. Fohmann asserts he has detected absorbents of this kind. This species of anastomosing between the veins and the lymphatics at their commencement, countenances a conjecture entertained by some, that the two systems of vessels have a common origin, and are distinct only when formed into vessels. By this arrangement, water, foreign substances, and those matters not intended to be assimilated, but to be rejected by the emunctories, are immediately introduced into the veins; while chyle and lymph, designed for nutritive processes, are carried into the general lymphatic system, subjected to the actions of the ganglions, and are advanced in a state of assimilation, when they have reached the venous system. A view of this kind has been proposed by Dr. GEDDINGS, of Charleston, S. C. in a well written essay on Absorption, in the Philadelphia Journal of the Medical and Physical Sciences, Vol. XIV. He, however, argues, that the separation takes place in the ganglions.

It is very certain, from the concurrence of reiterated observation and experiments, that, during the absorption of chyle by the lacteals, water, alcohol, and other matters, are not taken up by them. These substances cannot be detected in the chyle, while their presence is readily verified in the mesenteric veins. This fact explains the rapidity with which drinks, &c. are discharged from the bladder, or detected in the urine, without resorting, with Sir Everard Home, to the violent conjecture of a direct communication between the stomach and bladder; or the equally forced explanation of Darwin, of an inverted action of the absorbents.

The cellular tissue and lymphatic system, have a greater predominance in infancy and in females, than in riper age and in males. They have, consequently, an acute susceptibility, and are exceedingly liable to assume a morbid state in early life and in women. This disposition is lost with advancing years, and in age these tissues diminish in their relative proportion to the others: their diseases are, then, rarely met with.

The activity of absorption appears to hold a relation with the state of the circulation. When the vessels are plethoric, absorption languishes; and it acquires great activity by the diminution of their contents. This fact is fairly established by the experiments of Magendie, who found an artificial plethora, produced by injecting water into the veins, to prevent the poisoning of nux vomica inserted under the skin; and which ensued in shorter periods, according to the quantity of blood abstracted by bleeding. From this circumstance is seen the propriety of preceding the exhibition of those medicines whose effects proceed from their absorption, with depletion or abstinence. The same means should also be resorted to when it is desired to bring the absorbent functions into action in the treatment of disease; as the removal of indurations, tumours, effusions, &c.

Absorption, when it is languid or suspended, may be roused into activity by the direct application of excitant means. In this way the congestion caused by inflammation, and which often persists after the inflammatory action has subsided, is speedily dissipated by stimulants directly applied. This is seen in conjunctivitis after the acute stage has passed: any stimulant almost applied to the conjunctiva, will remove the congestion which alone remains. Indolent white tumours, and enlarged ganglions, when no sanguine irritation exists, are also frequently dissipated by irritating applications, as of iodine, and its preparations, &c.

Pathological State of the Function of Absorption.—The pathology of the absorbent system and function is far from having attained the precision and development that are desirable. Our information on this point is imperfect and obscure, and the etiology of their affections must prove unsettled and unsatisfactory, until our knowledge of the function itself be more definite and enlarged.

The lymphatic system is endowed with feeble sympathies, and is not very readily disordered by transmitted irritations of remote organs, except in those of a highly lymphatic temperament.

The diseases of the lymphatic system are of two different orders, that have not, heretofore, been properly discriminated. The one is the *inflammation or sanguine irritation* of the lymphatics and ganglions, analogous to inflammation in any other tissue, and affecting the mode of their nutrition: the other is disorder of its functional actions, affecting the mode or performance of its absorbing and its assimilating actions, or *simple lymphatic irritation.*

By irritation is meant an increment, always a reaction proceeding from an irritating cause, of the natural organic nutritive actions, or the functional actions of an organ, which tends to, or terminates in, their perversion or denaturalization.

Sanguine irritation or inflammation is the disorder, with augmentation and perversion of the molecular actions, of the red blood, and the elements of the tissues nourished by the fibrine and red globules: lymphatic irritation is disorder, with augmentation and perversion of the molecular actions, of the lymph or colourless blood, and the elements of the tissues composed from the albuminous principles. Both species of irritation are attended with a series or class of phenomena presenting different characters, as they are modified by the tissue, its anterior condition, function of the organ, the temperament of the individual, the development of organs, the state of the fluids, and probably nature of exciting cause.

The principal source of the *inflammation* of the lymphatic system, are impressions on the surfaces in which its radicles are seated, or irritations excited in those surfaces: it may also proceed from offending causes introduced by absorption.

The functional disturbances producing lymphatic irritation depend chiefly on the predominance of the cellular and lymphatic tissues, and an excess of lymphatic fluids. With this state constantly exists extreme susceptibility of the capillaries and structure connected with the lymphatic circulation, and which, consequently, suffers with facility aggressive impressions.

The inflammation or sanguine irritation of the mucous tissues, very rarely fails to be extended into the lymphatics arising from them. This fact was announced by Bichat, but has received much greater elucidation, and been placed in a more conspicuous light, by the researches of M. Broussais. The enlargement of the mesenteric ganglions, the result of their too active nutritive actions, and their suppuration, are always the consequence of enteritic irritation. This condition of those ganglions has been regarded as a specific disease, and as interfering with nutrition, by preventing the absorption of chyle. The emaciation of the patient is not, however, a consequence of any obstruction in the ganglions, as is supposed, for injections pass them with facility. It is to be accounted for by the imperfect chylosis, or production of chyle, the process of which is interrupted by the irritation of the digestive mucous tissue; by the disorder attending on absorption, caused by the morbid state of the mucous tissue in which the lacteals arise; and by the defective assimilation produced by the inflammation of the lacteals, and especially the mesenteric ganglions.

Inflammation, and especially, ulceration of the skin, is a common cause of inflammation in the lymphatic ganglions in the vicinity of the part affected. The neighbouring lymphatics will be seen inflamed, marked by a red streak on the skin, painful and hard to the touch; and the ganglions will become tumefied and suppurate. In this way are buboes formed by ulcers on the penis, by inflammation of the urethra, and by inflammation on the toes, &c.

The sanguine irritation, or acute inflammation of the lymphatics, is well characterized by the usual evidences of inflammation. They are red, tumefied, and painful. The ganglions, when inflamed, enlarge rapidly, become acutely painful, and suppurate easily. The tumefaction is confined chiefly to the gland, is hard and resisting, painful on pressure; it is generally well defined, and when advancing towards suppuration, the skin is of a clear red. The suppuration usually consists of laudable pus. The inflammation of the lymphatic ganglions occurs in those of the sanguine temperament.

A very different condition is frequently produced in those of the lymphatic temperament, and by the very same causes which have given rise to the preceding form of inflammation in the sanguine. The tumefaction is diffused around the ganglion, is doughy to the feel, but sometimes hard; it is but little painful, though in the nervous, and when renitent, it is occasionally sensible; and the skin is generally white, or but slightly reddened. A sense of fluctuation is often perceptible, leading to a supposition of a collection of pus; yet, if a lancet be introduced no pus is evacuated; blood mixed with lymph alone follows the puncture, and when the blood has ceased to flow, there is frequently a discharge of lymph solely. Purulent suppuration never, or certainly very rarely, takes place in this species of irritation. These are the phenomena characterizing the proper lymphatic irritation. In these cases the irritating cause occasions a lymphatic congestion. The white fluids being most abundant, and their appropriate vessels and tissues the most susceptible, the phenomena of irritation are manifested in them, as in the sanguine it is manifested in the red fluids, their vessels and tissues. The lymph, or white fluids, are determined towards the seat of irritation, absorption is suspended, and a lymphatic congestion ensues, precisely in the manner that red blood, in the sanguine temperament, accumulates around the point of irritation, and produces sanguine congestion. Instances of this kind I meet with constantly in individuals highly marked by the lymphatic temperament. I had a female patient, a married woman, affected with gonorrhœa by her husband, whose left groin, and a large portion of her abdomen presented this state of lymphatic engorgement. It is produced sometimes by chancres; I have seen it follow a furunculus on the thigh; and many cases of it caused by exposure to cold. I have known surgeons to misunderstand its character, and to insist on its syphilitic origin in such instances.

The chronic state of this form of irritation in the lymphatic tissues and circulation, constitutes scrofula, and gives origin to tubercles in the lungs, and other organs; and to scrofulous tumours in the neck, groins, &c.

It is highly important to make the discrimination between the sanguine irritation of the lymphatics, and this last form. For, while poulticing and warm fomentations give relief in the first, and promote a healthy suppuration, in the last, or simple lymphatic irritation, they enlarge and extend the swelling, increasing the lymphatic congestion and effusion of white fluids, rendering the disease more inveterate.

M. Broussais has recognized this form of irritation, which he names sub-inflammation. He has not, however, explained its phenomena, or appeared to understand the mode of their production. He further makes no discrimination between its acute and chronic degree, and does not sufficiently distinguish between it and the sanguine irritation or inflammation of the lymphatic vessels and ganglions. The acute state of it does not appear to have struck his attention, and his observations are, as far as I have seen, confined solely to the chronic degree.

From not enlarging on the nature of the phenomena of lymphatic irritation, or sub-inflammation, as he terms it, some of his pupils reject it as unfounded. This is the case with M. Begin. The objections of this gentleman turn on two points: the first is, that the anatomical disposition of the lymphatic vessels must cause their fluids to flow from the periphery to the centre, and, consequently, cannot admit the congestion, or a radiatory convergence and accumulation of lymph towards an irritated point, as occurs with red blood: and second, that on anatomico-pathological examination, the evidences of inflammation are found as in other tissues.

The first of these objections is founded on an entire misconception of the lymphatic system, and of the phenomena of its irritation. The lymphatics are the returning vessels of the lymph, or white blood, as the veins are the returning vessels of the red blood. The lymphatics absorb the white blood from the capillaries and areolar tissue, into which it alone penetrates in a natural state, as the veins absorb the red blood from the capillaries and areolar tissues in which it circulates. The lymphatic trunks are no further concerned in the phenomena of lymphatic irritation, than the veins are in sanguine irritation or inflammation. Lymphatic irritation is seated in the lymphatic capillaries, and the tissues in which white fluids alone penetrate, in the same manner as inflammation is seated in sanguine or red capillaries, and the tissues nourished by red blood. The lymphatic trunks or vessels are foreign to lymphatic irritation, as the venous trunks or vessels are foreign to inflammation or sanguine irritation. It would be as valid an objection to the existence of sanguine irritation, that the veins do not admit a retrograde course of their fluids, as it is to lymphatic irritation, that the lymphatics do not suffer a retrocession of their fluids. The first objection of M. Begin is, then, invalid; possesses no cogency, being founded on a misconception of the phenomena composing lymphatic irritation, or the sub-inflammation of Broussais.

His second objection is equally destitute of weight. It arises from confounding the *sanguine inflammation* of the lymphatic ganglions, always developed in the advanced progress of their diseases, with simple *lymphatic irritation.* Besides, lymphatic irritation is not necessarily connected with enlarged lymphatic ganglions. They are often inflamed independently of any affection of the lymphatic capillaries, and these sometimes manifest the characters of their peculiar irritation, while the ganglions remain unaffected.

Lymphatic irritation is productive of various morbid changes in the lymph or white blood, and in the mode of nutrition of the white tissues. The most common production of this kind are tubercles, developed with so much facility in the lungs, compressing and destroying their tissue, in those endowed with the lymphatic temperament. Tubercles, though more frequently formed in the lungs than in other organs, are found in most of the tissues. Next to the lungs the serous membranes are most frequently their seat, but they occur in almost every portion of the animal structure.

The nature and production of tubercles have been subjects of constant discussion. Bayle and Laennec, with very little evidence to support their opinions, regard them as possessing a distinct vitality from the surrounding tissues, which have no share in their production; and that they are a species of morbid organized tissue. Baron, on grounds no stronger, supposes them to be, in their origin, a species of hydatids, subsequently becoming concrete and converted into tubercles. These opinions are not entitled to weight, being little more than bare conjectures.

Tubercles do not exhibit, according to Gendrin, the globules of fibrin, or of true pus, but yield albumen on examination. They occur most readily in those of the lymphatic temperament, in whom the white tissues, and the lymphatic fluids, (which are albuminous,) are predominant, and in their commencement, contrary to the assertion of Laennec, they are fluid, or of a soft consistency. Tubercles are, then, it is most probable, a species of lymphatic pus, or a morbid secretion resulting from an irritation in the lymphatic vessels and tissues in which the white fluids circulate; and whose characteristic property is to assume the concrete state

The opinion in respect to their production, entitled to most consideration, and which I have found in my researches sustained by observation, is that of M. Broussais. This distinguished pathologist places their seat in the white capillaries and lymphatic ganglions, and attributes them to an irritation developed in those tissues. This irritation of the white capillaries is frequently excited by sanguine irritation or inflammation in adjacent tissues. Inflammation, for instance, of the bronchial mucous membrane, will give rise to the formation of tubercles in the parenchyma of the lungs.

The irritations of both sets of capillaries, the red and the white, are often also concurrent, as is seen in some cases of pneumonic inflammation, in which tubercles are developed amidst the alterations of structure proceeding from sanguine irritation. M. Broussais has not sufficiently distinguished between the two irritations to render his meaning clear and distinct. Hence, Laennec, Gendrin, and Louis, who oppose his views, found their objections entirely on grounds irrelative to the question. Their arguments turn entirely on *sanguine irritation or inflammation*, as the proximate cause of tubercles, while it is only asserted to be one of the occasional or exciting causes of *lymphatic irritation*, the proper proximate cause of the formation of tubercles.

The lymphatic capillaries, the white tissues, and the albuminous fluids, are the subjects of other morbid formations, a consequence of irritation provoked in them, and giving rise to a perverted mode of nutrition—such as scirrhus, encephaloid tumours, and other morbid formations of a cancerous nature.

Absorption we have presented as a function equally exercised by the veins and lymphatics, and intimately concerned in the nutritive movements of the fluids, or the circulation, as it is generally termed. If this view of the function be admitted as correct, it must enter as an element into the morbid states of the circulation, or the movements of the fluids. In inflammation a stasis of the fluids exists, they accumulate in the part where this state has been excited, and a congestion is produced. This condition does not arise from any difficulty in the direct circulation, or that where the blood passes immediately from afferent or arterial into efferent or venous vessels, for the veins proceeding from an inflamed part are distended with blood, and fill up rapidly if the blood be pressed out of them. The congestion, then, must proceed from the suspension of absorption by the venous radicles, the mode in which the blood is returned back into the general circulation from the capillary and interstitial, or areolar circulation. This circumstance has been overlooked in all the theories of inflammation, yet it appears to me to constitute one of its essential characters.

The defect of venous absorption frequently subsists after the first period of irritation has passed away, and the congestion, or blood stagnating in the tissue, continues from this cause. The application of an excitant in this state, by awakening absorption, occasions an almost immediate disappearance of the redness and tumefaction that have remained persistant after the cause inducing them had ceased. This passive condition is often confounded with the active period of inflammation, and those who do not understand the different phenomena comprehended under the term inflammation, are led into false conclusions, and sometimes most erroneous practice, from the fact above stated: they suppose it an evidence that inflammation can be cured by excitants, and are induced to resort to their employment in the active periods of inflammation; a practice fraught with great hazard to the integrity of the organs and life of the patient.

The same defect of absorption occurs in simple lymphatic irritation, and the congested lymphatic humours collect and stagnate in the tissue where the irritation is developed. Hence proceeds the tumefaction, generally colourless, that attends it, and the lymphatic fluids which issue when an opening is made.

The collection of serous fluids constituting the various forms of dropsy, has been attributed to defective absorption in the lymphatics, independent of any inflammatory action. It was supposed that an equilibrium existed between the exhalation of the serous sacs and cellular tissue, and the absorbing function of the lymphatics, and that a loss of power in these last, suspending their function, was sufficient to cause an accumulation of the exhaled fluid, and to form dropsical collections. This doctrine is, however, a pure hypothesis, and is not substantiated by any positive facts. In the experiments of Munro and of Dupuytren, who secured the thoracic duct in animals by ligatures, no dropsical swellings were induced by the suspended function of the lymphatics. Sir Astley Cooper has recorded a case of obliteration of the thoracic duct, in which also no dropsical collections had occurred; and the same circumstances have been observed by M. Andral, the younger.

On the contrary, ligatures on the veins, and obliterations of those vessels by the inflammation of their lining membrane, an occurrence by no means rare, are invariably productive of dropsical effusions, showing that the serous or aqueous portion of the sanguine fluid is absorbed and returned into the circulation by veins, and not by lymphatics. From the defects of absorption, by the obliteration of the cavities of venous trunks, or other causes impeding the transmission of the blood through them, dropsies may frequently be induced; but the most usual proximate cause is inflammation of the serous sac, or the cellular tissue, in which the effusion exists.

Dropsies may, however, exist, independent of inflammation. At least, I have often examined subjects that have perished under chronic ascites, in which no trace of inflammation or alteration of structure could be detected in the peritoneum. In the dropsical effusions accompanying the close of the organic diseases of the heart, this is uniformly the case. Not the slightest morbid change is perceptible in the tissues from which the effusion has proceeded. We do not know to what extent the phenomena of endosmose and exosmose prevail in the animal economy, or the part they may perform in the process of absorption. But it is completely established that endosmose is quite adequate to the production of absorption, and exosmose of effusion. Inflammation may be a cause of effusion, by the modification it imparts to these actions; and they may be perverted by causes that do not produce inflammation, yet occasion serous effusions.

The milk leg, as it has been termed, or phlegmasia alba dolens, succeeding so frequently on parturition, it would appear from recent examinations, proceeds in some instances, at least, from inflammation of the large trunks of the veins obliterating their cavities by the formation of coagula or fibrin. In this disease the cellular membrane of the affected limb is distended with a sero-albuminous fluid, causing a dense tumefaction: absorption here appears to be suspended by the loss of function in the veins. This affection is, however, not unfrequently complicated with lymphatic irritation.

Absorption may deviate from its normal state by its too great activity. It occurs as a symptom in different diseases, but cannot be regarded as a distinct affection. In fevers emaciation is rapidly produced by the absorption of the fat and cellular fluids; but in chronic affections every portion of the structure is wasted, even to the substance of the bones, constituting *atrophy.* I witnessed a case of atrophy attended with severe pain in the extremities and the trunk, and with extreme tenderness to pressure. The appetite was good, the nutrition abundant, and the gastric digestion free of embarrassment. The wasting of the frame, notwithstanding, gradually progressed, and arrived at the last possible extent. After death chronic inflammation and ulceration of the lower bowels were found to exist, but, from the regularity of the alvine discharges, and their natural appearance during the earlier periods of the disease, it is doubtful whether they occured until a short time previous to its close.

Absorption, composing part of the complex phenomena of which nutrition consists, enters into the deviations disturbing the order of this function. In a healthy state, a certain equilibrium is maintained between the processes of composition and decomposition composing the nutritive function. It is not uncommon for this equilibrium to be lost, and the balance be directed to the one side or the other, without a positive perversion of the function: when the process of composition possesses the ascendancy, nutrition is in excess, and hypertrophy prevails; when decomposition and absorption obtain the superiority, atropia, or the wasting of the solids, is the predominant phenomenon. In a morbid condition, perversion of the function ensues, and absorption, when unduly active, occasions thinning, softening, ulceration, and other modes of the destruction of the tissues.